This exam is composed of 25 questions. Go initially through the exam and answer the questions you can answer quickly. Then go back and try the ones that are more challenging to you and/or that require calculations.

As discussed on the course syllabus, honesty and integrity are absolute essentials for this class. In fairness to others, dishonest behavior will be dealt with to the full extent of University regulations.

1. How many valence electrons are in the S atom?
   1) 2  2) 3  3) 8  4) 6  5) 4

2. Which atom(s) has/have completely filled 3s, 3p, and 3d orbitals?
   1) Ar  2) Zn  3) Kr  4) Kr & Zn  5) Ar & Zn

3. Which element is represented by: \(1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^4\)
   1) As  2) Se  3) Br  4) Sb  5) Te

4. The orbital depicted at right is:
   1) 1s  2) 2p  3) 3s  4) 3p  5) 4p
5. The orbital depicted at right is:

   1) $p_{xy}$  2) $d_{xy}$  3) $d_{x^2-y^2}$  4) $d_{z^2}$  5) $f_{xy}$

6. Which of the following quantum number sets is *not* allowed?

   1) $n=3\ l=2\ m_l=-1\ m_s=+1/2$  2) $n=2\ l=2\ m_l=-1\ m_s=+1/2$
   3) $n=3\ l=1\ m_l=-1\ m_s=-1/2$  4) $n=2\ l=0\ m_l=0\ m_s=+1/2$
   5) $n=3\ l=0\ m_l=0\ m_s=-1/2$

7. What is the maximum number of orbitals that can be identified by the set of quantum numbers $n=3\ l=1$?

   1) 2  2) 3  3) 5  4) 6  5) 7

8. Which of the following has the shortest bond length?

   1) $H_2O$  2) $NH_3$  3) HF  4) $CH_4$

9. Which of the following has the highest bond energy?

   1) $N_2$  2) $C_2$  3) $B_2$  4) $O_2$  5) $F_2$
10. The CO bond in the molecule CH₃O⁻ is best described as a:
   1) ionic bond  
   2) double bond
   3) triple bond  
   4) single bond
   5) the molecule doesn’t exist

11. Consider the molecule SO₃ₓ, where x is the charge on the molecule. All three bonds are single bonds. Which value of x yields the stable molecule? (Hint: draw Lewis structures to figure this one out)
   1) +2
   2) +1
   3) 0
   4) –1
   5) –2

12. For the SO₃ₓ molecule above, how many equal-energy resonance structures can you draw?
   1) 1
   2) 2
   3) 3
   4) 4
   5) 6

13. The NO bond in HNO is a:
   1) single bond  
   2) double bond
   3) triple bond  
   4) ionic bond

14. If an element with the valence configuration ⁴s²³d⁷ loses 2 electron(s), these electron(s) would be removed from the following subshell(s).
   1) 4s
   2) 3d
   3) 4s and 3d
   4) 3p
   5) 4p
15. Which molecule below does not exist?
   1) BeF₂   2) CaF₂   3) MgO   4) KCl   5) BCl₂

16. Draw a stable Lewis structure for the symmetrical molecule hydrogen peroxide O₂H₂. In this structure, how many lone pair electrons are on each O?
   1) 1   2) 2   3) 6   4) 3   5) 4

17. Draw a stable Lewis structure for the molecule OCS. In this structure (with C at the center), what is the bond order between C and S?
   1) 1   2) 2   3) 3   4) 0.5   5) 1.5

18. Draw the best Lewis structure for NF₂⁻. How many lone pair electrons are located on N?
   1) 1   2) 2   3) 3   4) 4   5) 6

19. For the molecule NF₂⁻, what is the electron group geometry of N?
   1) linear   2) tetrahedral   3) trigonal planar
   4) trigonal bipyramidal   5) octahedral
20. In the molecule \textbf{NO}_2^+ , the actual bond order for each NO bond is:
   1) 1  
   2) 2  
   3) 3  
   4) 1.5
   5) 1 for one bond and 2 for the other

21. Draw the Lewis structure for \textbf{XeF}_4. The electron group geometry is:
   1) square planar  
   2) square pyramidal  
   3) trigonal bipyramidal  
   4) octahedral  
   5) none of the above

<table>
<thead>
<tr>
<th>Bond Dissociation Energies (kJ mol(^{-1}), gas phase)</th>
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<tbody>
<tr>
<td>Bond</td>
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<tr>
<td>H-H</td>
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<tr>
<td>C-H</td>
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<tr>
<td>N-H</td>
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<tr>
<td>O-H</td>
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22. Consider the reaction: \textbf{H}_2\text{NNH}_2 (g) + \textbf{H}_2 (g) \rightarrow 2 \textbf{NH}_3 (g)

What is the energy (\(\Delta H^\circ\), in kJ mol\(^{-1}\)) for this reaction?
   1) –183  
   2) +183  
   3) –163  
   4) +163  
   5) –273
   5) –1 for one O and 0 for the other O
(Questions 23-24) Consider the following resonance forms for the ion ONC\textsuperscript{−}:

![Resonance forms](image)

23. In resonance structure c, what is the formal charge on C?
   1) –3  
   2) –2  
   3) –1  
   4) 0  
   5) +1

24. Which resonance structure is lower in energy, b or c?
   1) c  
   2) b  
   3) neither, they have the same energy

25. The correct designator for this course is:
   1) Chem 363  
   2) Sports 99  
   3) Econ 3.33  
   4) Chem 111

PERIODIC TABLE OF THE ELEMENTS